

The Canadian Entomologist.

VOL. XXIV.

LONDON, JANUARY, 1892. *

No. 1.

CAN INSECTS SURVIVE FREEZING? *

BY H. H. LUMAN, MONTREAL.

In a foot note to his paper on "The Butterflies of Laggan" (CAN. ENT., XXII., 129), Mr. Bean says: "I hope none of my younger readers entertain the absurd mediæval superstition that hibernating caterpillars pass the winter in a *frozen condition*. In successful hibernation they do not get near to such a condition; but if they do absolutely freeze, then are they undone caterpillars. Valkyria gives them sleep, unmixed with dreams, and they wake in Valhalla."

Without entering into any discussion as to my relative age in comparison with Mr. Bean's, I may confess that I have long believed that *some* caterpillars, as well as insects in other stages, can and do survive freezing. And, finding my belief so distinctly challenged, I have endeavored to find some light upon this subject from such literature as is accessible to me, and from personal testimony.

The first work to which I turned was Scudder's "Butterflies of New England".

In this work there is an Excursus, No. XVII., on "Lethargy in Caterpillars", and another, No. XXII., on "The Hibernation of Caterpillars," but in neither is any light thrown upon this question.

In the same author's "Butterflies" but little more is said upon this subject. On page 135, in writing of *Colias philodice*, he says: "Winter overtakes at once caterpillars of various ages, chrysalids and butterflies, and probably eggs. The experience of breeders, and the diversity in the time of appearance of the butterflies in the spring, render it probable that the cold season kills not only the butterflies and eggs, but perhaps the chrysalids as well, leaving the caterpillars to renew the life of the species in the spring."

* Read before the Annual Meeting of the Entomological Society of Ontario, November 25th, 1891.

But, though I have failed to gather from his works any information upon this subject, I have learned from him personally, and by letter, some facts which may be thought to throw some light upon this question. About thirty-five years ago Mr. Scudder was prodding for beetles in some hole of a rotten stump in winter at Williamstown, Mass., and came across several caterpillars of *Isabella*, and breaking at least one in two found it brittle, like an icicle, and he believes he noticed crystals within, and, therefore took two or three home to his room to see if they would come to life, which one or more did. Mr. Scudder, however, does not lay much weight on these facts, and adds: "I may or may not have broken more than one, and do not at all remember whether only one or all came to life, but of course I *may* have broken only one, and that one already dead."

I have recently seen somewhere, where I cannot now say, though I have spent hours in searching for the reference, an account of a caterpillar being found frozen into a cake of ice. The finder cut out a cube of the ice containing the caterpillar by means of a red-hot poker, and then left the block on the sill outside his window for several days, while the temperature ranged below zero. Upon bringing it into the house and thawing out the larva, it revived, and became quite active, but further experiment was prevented by its spinning its cocoon.

In Mr. Fletcher's report for 1889 (Experimental Farm Reports, 1889, p. 79), it is recorded that four larvæ of the Mediterranean Flour Moth (*Ephestia Kühniella*, Zeller) were placed in a glass vial out of doors for half an hour when the temperature was only five degrees above zero F., and as a result were frozen hard, so that they "rattled like glass beads against the sides of the bottle". Of the four, two never recovered at all, but the other two revived partially and retained their natural appearance for about a fortnight, and moved their bodies a little, though they finally succumbed. The Rev. T. W. Fyles has kindly given me the following particulars of his experience with larvæ of Coleoptera: "In the winter of 1864-5, I was splitting up decaying hemlock logs in my pasture at Iron Hill, P. Q., intending to burn them in the spring. On several occasions I found in these logs numbers of the larvæ of *Orthosoma unicolor* in a torpid state. In some cases the water had percolated into the burrows of the insects and frozen around their occupants. One day I picked out a number of the largest grubs from their icy envelopments, and found them rigid and seemingly lifeless. I took them to my house and watched them as they slowly thawed into activity."

Dr. John Hamilton, of Alleghany, Pa., on the other hand, found, as related in his interesting paper in CAN. ENT., XVII., p. 35, that he could not revive specimens of Coleoptera which were unquestionably frozen, though some larvæ inclosed in cylinders of ice were still found to be flexible, and regained activity on a rise of temperature.

Though Dr. Hamilton's experience was decidedly against the theory that actual freezing does not necessarily cause death in insects, he still admits that a good deal of evidence has been adduced on the other side, and that records of the survival of frozen insects cannot be summarily dismissed.

To turn to some of the older writers on entomology, I may quote the following from Kirby & Spence's "Introduction to Entomology", Vol. II., second edition. On page 231, after referring to some very extraordinary instances of the survival of insects under such trying circumstances as immersion in gin for twenty-four hours, and immersion in boiling water, the authors say: "Other insects are as remarkable for bearing any degree of cold. Some gnats that De Geer observed survived after the water in which they were was frozen into a solid mass of ice: and Reaumer relates many similar instances." Later, on pages 452-3 of the same volume, in treating of "Hibernation of Insects" I find the following very interesting remarks: "But, though many larvæ and pupæ are able to resist a great degree of cold, when it increases to a certain extent they yield to its intensity and become solid masses of ice. In this state we should think it impossible that they should ever revive. That an animal whose juices, muscles and whole body have been subjected to a process which splits bomb shells, and converted into an icy mass that may be snapped asunder like a piece of glass, should ever recover its vital powers, seems at first view little less than a miracle; and, if the reviviscency of the wheel animal (*Vorticella rotatoria*) and of snails, etc., after years of desiccation, had not made us familiar with similar prodigies, might have been pronounced impossible; and it is probable that many insects when thus frozen never do revive. Of the fact, however, as to several species, there is no doubt. It was first noticed by Lister, who relates that he had found caterpillars so frozen that when dropped into a glass they clinked like stones, which nevertheless revived. Reaumer, indeed, repeated this experiment without success, and found that when the larvæ of *Bombyx ptyocampa*, F., were frozen into ice by a cold of 15° R. below zero (2° F. below zero), they could not be made

to revive. But other trials have fully confirmed Lister's observations. My friend, Mr. Stickney, the author of a valuable 'Essay on the Grub' (larva of *Tipula oleracea*)—to ascertain the effect of cold in destroying this insect, exposed some of them to a severe frost, which congealed them into perfect masses of ice. When broken their whole interior was found to be frozen; yet several of these resumed their active powers. Bonnet had precisely the same result with the pupæ of *Papilio brassicæ*, which, by exposing to a frost of 14° R. below zero (0° F.), became lumps of ice, and yet produced butterflies. Indeed, the circumstance that animals of a much more complex organization than insects, namely, serpents and fishes, have been known to revive after being frozen, is sufficient to dispel any doubts on this head."

In Burmeister's "Manual of Entomology" the above instances are also referred to, though at much less length; but, as no additional facts are adduced, it is unnecessary to quote from his work.

The above would seem sufficient to establish the proposition that some insects can survive freezing, and, indeed, when one remembers that insects successfully maintain their existence in the most arctic lands which have ever been visited by man, it seems strange that anyone should ever have questioned it. Is it conceivable that these tiny creatures, when in a state of lethargy and partaking of no nourishment, could successfully resist yielding to frost in regions subject to a temperature of 75° F. below zero, and where in summer the soil only thaws to the depth of twelve or fifteen inches, the ground below this depth being perpetually frozen?

The meteorological tables of the English arctic expedition of 1875-6 show that the mean temperature of the winter months at the stations of the two vessels, "Alert" and "Discovery", varied from 5° F. below zero in October, and 17° F. below zero in April, to 40° F. below zero in the middle of the winter, and that the minimum temperatures reached were:— $73\frac{3}{4}^{\circ}$ F. at the winter quarters of the first named vessel, and -70.8° F. at the station of the latter in Discovery Bay.

In spite of these terrible temperatures the naturalists attached to the expedition were very successful, and Mr. Robert McLachlan, F. R. S., to whom the collections of insects were submitted, wrote as follows in his

report: "The materials brought home from between the parallels 78° and 83° N. latitude, showed quite unexpected, and in some respects astonishing results. I have no hesitation in saying that the most valuable of all the zoological collections are those belonging to the entomological section, because these latter prove the existence of a comparatively rich insect fauna, and even of several species of showy butterflies, in very high latitudes."

But the most interesting account of experiments on this subject which I have seen, is that given by Commander James Ross, R. N., F. R. S., and inserted by Curtis in the Entomological Appendix to the "Narrative" of Sir John Ross's second arctic voyage. The experiments were tried upon the caterpillars of *Laria Rossii*, a very abundant species in Boothia Felix, and doubtless all through the arctic regions of this continent. The account (page lxxi.) is as follows: "About thirty of the caterpillars were put into a box in the middle of September, and after being exposed to the severe winter temperature of the next three months, they were brought into a warm cabin, where, in less than two hours, everyone of them returned to life, and continued for a whole day walking about; they were again exposed to the air at a temperature of about 40° below zero, and became immediately hard frozen; in this state they remained a week, and on being brought again into the cabin, only twenty-three came to life; these were, at the end of four hours, put out once more into the air, and again hard frozen; after another week they were brought in, when only eleven were restored to life; a fourth time they were exposed to the winter temperature, and only two returned to life on being again brought into the cabin; these two survived the winter, and in May an imperfect *Laria* was produced from one, and six flies from the other."

That a caterpillar infested with parasites should have been able to survive such severe treatment and spin its cocoon is most remarkable, and it is not to be wondered at that alternate freezing and thawing should have been disastrous to the majority of those experimented upon. Many other similar accounts doubtless exist, but I think that the records which I have thus brought together are sufficient to prove that actual freezing is not necessarily fatal to insects, and that Mr. Bean had no sufficient warrant for the statement quoted at the beginning of this article.

DESCRIPTIONS OF SOME BUTTERFLY LARVÆ FROM
YOSEMITE (V.), AND THE LIFE HISTORY OF
CALLIDRYAS EUBULE.

BY HARRISON G. DYAR.

Pyrameis cardui, Linn.

The life history of this well-known species has not been written, to judge from the references given by the late Mr. Henry Edwards in his useful catalogue, so I present it here :—

Egg.—Cylindric-conical, the base flat with the usual vertical ribs ; colour pale yellow ; diameter .6 mm. Laid singly.

First larval stage.—Head rounded, black and shining ; width .3 mm. Cervical shield and anal plate black ; body very blackish with a number of short dark hairs ; feet normal. The larva lives under a slight web on surface of leaf.

Second stage.—Head as before with a few hairs ; width .6 mm. Body dull black, furnished with rows of short conical blackish tubercles each with a long hair ; the tubercles of the rows (1) and (2) on joints 6, 8 and 10 are pale yellow. Hair blackish ; feet black.

Third stage.—Head slightly bilobed, black, shining, a few black hairs from minute tubercles ; width 1.1 mm. Body black, covered with spined processes arranged as in *Grapta**, all black except the three dorsal ones on joints 6, 8 and 10 which are yellow, but with black spines.

Fourth stage.—Head bilobed, uniform shining black, with many black hairs arising from elevated bases ; width 1.9 mm. Body black, minutely dotted with yellow ; processes black except the bases of the three dorsal ones on joints 6, 8 and 10, which are dark yellow. As the stage advances a very narrow geminate dorsal and single subventral broken yellow line appears. The larvæ live singly under nets constructed of silk supported on a leaf.

Fifth stage.—Head rounded, uniform sublustrous black, the mouth parts paler and bases of antennæ reddish ; covered with black hairs of considerable length, which arise from small tubercles ; width 3.5 mm. Body deep black, brownish subventrally and on the legs, with numerous minute yellow piliferous tubercles bearing whitish hairs. The shafts of the processes are all more or less colourless, but the branches and tips are all black and the bases are shining blue-black. There is a row of inter-

* See "Descriptions of some Butterfly larvæ from Yosemite," No. VI.

segmental stigmatal red dots and a similar row of larger substigmatal yellow dots. Claspers of abdominal feet pale. In some examples the substigmatal yellow dashes almost form a continuous band, and there are indications of a geminate yellowish dorsal line; but this latter marking almost disappears under a lens.

Chrysalis.—Head large, eyes prominent, thorax very slightly ridged along the dorsal line with an elevated point posteriorly centrally and a pair of smaller subdorsal points, two points on the lateral edge of wing cases and one near the middle of outer margin of wing. Abdomen rounded dorsally, nearly straight ventrally, with a subdorsal row of conical points; cremaster broad and flat, colour sordid white with an obscure golden tint, dotted with black and shaded with smoky gray, broadly so dorsally (except a narrow dorsal line), narrowly stigmataly, broadly ventrally, and more irregularly and clouded over the thorax and cases. All the points tinged with shining gold or bronze. Length 13 mm.; width 6 mm.

Food-plants.—Lupine (*Lupinus*) and thistle (*Carduus*).

Callidryas eubule, Linn.

Egg.—Spindle shaped, truncated on basal end, distinctly vertically ribbed and faintly transversely striated. Colour pale white, becoming ochre yellow before hatching. Length 1 mm.; diameter .3 mm.

First larval stage.—Head round, smooth, ochre yellow, the ocelli dark brown; width .3 mm. Body smooth, concolorous with head, with a number of long tapering setae, curving forward, about six on each joint.

Second stage.—Head rounded, subtranslucent yellowish; width .5 mm. Body cylindrical, pale yellow, with many short hairs arising from granulations of considerable size. Some of these hairs overhang the head and many terminate in a little knob. Under the microscope the setae are seen to be all glandular, transparent and swollen at tip, and arise from large conical tubercles, between which the body is very minutely punctured.

Third stage.—Head pale green, mouth parts yellowish, many short pale setae; width .8 mm. Body annulated, about six annulets per segment. Colour yellowish green, not shiny, with a distinct rather broad, pale green stigmatal line. The fleshy tubercles on the body are slight, the setae very short but slightly blackish and bear at tip large, round, clear liquid drops.

Fourth stage.—Head round, leaf green, mouth parts yellow; many short hairs arising from black conical granulations; width 1.5 mm. Body leaf green with a paler stigmatal line and thickly covered with black conical granulations, some of which are larger than others and surrounded by pale green, and all bear short setae. Under the microscope these granulations are seen to arise from swollen green bases and the setae each terminate in a clear spherical drop.

Fifth stage.—Head small in comparison with body, round, leaf green, thickly covered with conical granulations bearing minute setae, concolorous with head, but a few of the larger ones are blue-black; width 2.4 mm. Body cylindrical, 5 mm. thick, dark leaf green with a distinct rather broad, yellow stigmatal line strongly shaded with orange, extending the whole length of the body and bordering the anal plate. Six annulets per segment, each annulet containing some twelve conical blue-black granulations, surrounded by bluish green at the base. Only a few of these occur below the stigmatal line and then in the middle of the joints where, also, just above the stigmatal line, and sometimes partly below it, the granulations are connected by black, forming incipient transverse bands on the annulets. The granulations are each tipped by a short black seta. Feet and venter pale green, nearly smooth. The body is very minutely punctured between the granulations when seen under the microscope.

Chrysalis.—Suspended by the cremaster and a long very slight silken loop. Thorax bent up at an angle of 45° with the body, rounded, a slight depression posterior to it; a long pointed process on the head like a horn, almost continuous with the sides of the body. Wing cases enormously, developed, projecting more than the thickness of the body, evenly rounded along ventral line, flattened laterally and tapering ventrally to an edge. Abdomen cylindrical, tapering; cremaster flattened, a little excavated below. Colour dark pinkish vinaceous†, or pea-green‡, with a greenish dorsal and lateral band, bordered with pale yellow; ventral line and veins of wing-cases narrowly yellowish. Length 25 mm.; thickness through wing cases from dorsum to venter 10 mm.; thickness of abdomen posterior to cases 4 mm.; width of body 5 mm.

Food-plant.—Senna (*Cassia*.)

Larvæ from Santa Barbara, Cal.

† Ridgway's Nomenclature of Colours, pl. iv., fig. 18.

‡ Op. Cit., pl. x., fig. 9.

REVISION OF THE BOMBYLID GENUS EPACMUS
(LEPTOCHILUS).

BY D. W. COQUILLET, LOS ANGELES, CAL.

In the CANADIAN ENTOMOLOGIST for May, 1886, I gave descriptions of the only two species of *Leptochilus* at that time known to inhabit North America. I am not aware that any additional species have been described since the appearance of that paper. My collection contains representatives of three as yet undescribed species which will be found duly characterized below.

In the *Biologia Centrali Americana*, Part Diptera, the Baron Osten Sacken calls attention to the fact that the name *Leptochilus*, first applied to this genus by Dr. Loew, is preoccupied, and proposes the name *Epacmus* to be used in its stead. It is to be regretted that the rules of nomenclature will not permit us to attach Dr. Loew's name to this new term; the genus is rightfully his from the fact that he first characterized it after an extended search among the writings of other authors, and it seems hardly fair to deprive him of this honour simply because he inadvertently applied to it a name already in use. Perhaps we might compromise matters somewhat by writing the name of this genus: *Epacmus* Osten Sacken-Loew, which would indicate a joint work of these two authors.

Following is a table of the species of *Epacmus* known to me to occur in North America:

1. Ground colour of the abdomen black 2
Ground colour of the abdomen yellow, its tomentum golden-yellow
except a white crossband on the second segment . *concinus*
n. sp.
2. Wings (except sometimes the costal and subcostal cells) wholly
hyaline, front and face furnished with tomentum 3
Wings smoky-brown at the base, front and face destitute of tomen-
tum 4
3. Scutellum shallowly concave behind, hind and middle femora and
front tibiæ provided with bristles *modestus*, Lw.
Scutellum convex behind, all femora and the front tibiæ destitute of
bristles *pellucidus*, n. sp.
4. Hind femora and front tibiæ provided with bristles, scutellum pol-
ished black *transitus*, Coq.
Hind femora and front tibiæ destitute of bristles, scutellum opaque
fumed *fumosus*, n. sp.

Epacmus concinnus, n. sp.—Head black, front densely white pollinose, destitute of tomentum, the middle portion sparse white pilose, the orbits and space in centre of lower third of front bare; face much retreating below, densely white pollinose, destitute of tomentum, the lower three-fourths densely white pilose. Proboscis not projecting beyond the oral margin. Antennæ having the first two joints yellow, the third black and nearly twice as long as the first two united; styliform portion of the third joint one-half as long as the thickened basal part. Occiput yellowish tomentose. Thorax black, the anterior third white tomentose, the remainder yellowish tomentose; pile of thorax sparse and mostly yellowish, the bristles also yellowish; pleura dense white tomentose and sparse yellowish pilose. Scutellum opaque black, rounded behind, white and yellowish tomentose, the bristles yellowish. Abdomen reddish-yellow, its tomentum and pile golden-yellow except a wide crossband of white tomentum on the second segment; venter yellow, blackish at its base, its pile and tomentum yellowish except that at the base, which is white. Legs yellow, a black spot at base of each trochanter; tomentum and bristles of legs yellowish, hind femora each with three bristles below, front tibiæ provided with bristles. Wings wholly hyaline. Stalk of halteres brownish-yellow, the knob sulphur yellow. Length 7 mm. San Diego county, Cal. A single female, in May.

Epacmus pellucidus, n. sp.—Black, the femora, tibiæ and base of each tarsus reddish. Front densely dark brown and yellowish-white tomentose and pilose, the pile very short; face slightly produced below, white tomentose and yellow pilose. Proboscis not projecting beyond the oral margin. Antennæ having the second joint minute and scarcely apparent; styliform portion of the third joint equal in length to the thickened basal part. Occiput white tomentose, that in the middle above reddish-brown. Thorax reddish tomentose, the bristles white (only two in number, one in front of each wing); pile and tomentum of the pleura, breast and coxæ white. Scutellum opaque, rounded behind, reddish tomentose, the pile and bristles wholly wanting. Abdomen mixed reddish and yellowish tomentose, that on the last two segments wholly white; last segment polished black, the pile on its apex golden-yellow; dorsum nearly destitute of pile, first segment toward its sides abundant white pilose; venter yellowish-white tomentose. Legs white tomentose, all femora and the front tibiæ destitute of bristles. Wings hyaline, apex of subcostal cell

yellowish Stalk of halteres dark yellow, the knob light yellowish. Length 6 mm. Los Angeles county, Cal. A single female, in June.

Epacmus fumosus, n. sp.—Black, the tibiæ largely reddish. Front black pilose, destitute of tomentum; face slightly produced below, destitute of tomentum, the pile yellow, that in the middle black. Proboscis not projecting beyond the oral margin. Antennæ having first joint twice as long as the second, styliform portion of the third joint once and a-half as long as the thickened basal part. Occiput light yellow tomentose and pilose. Thorax light yellow tomentose, the bristles yellowish; pleura having pile of the upper part yellowish, that on the lower part, breast and coxæ white. Scutellum opaque, rounded behind, yellow tomentose, the bristles reddish. Abdomen somewhat abraded in my specimen, but apparently wholly light yellow tomentose; pile of dorsum sparse, yellowish, that on the sides more abundant, especially on the first segment, white; venter white tomentose and pilose. Legs mixed white and yellow tomentose, all femora and the front tibiæ destitute of bristles. Wings hyaline at the apex, the costal cell, bases of marginal, first submarginal, first and second basal and of the anal cell smoky-brown, which colour does not have a well defined limit outwardly. Stalk of halteres dark yellow, the knob light yellow. Length 6 mm. San Diego county, Cal. A single female, in May.

HETÆRINA AMERICANA.

There was brought to me by Mr. T. H. Hill, of this city, one of our young collectors, a dragon fly captured at Delaware, a village a few miles west of here. It was one I had not seen before. On referring to Glover's Plates I found it there, figured and named. It is *Hetærina Americana*, Fab., the *Lestes basalis* of Say, in the family Agrionidæ; a beautiful creature. Its most noticeable characteristics are the bright sanguineous colour on the base of the wings, the clear copper colour of the thorax, and the brilliant gem-like ornamentation of the head. Say gives the habitats as Missouri, Indiana and Massachusetts. Abundant, and easily taken. I am not aware of its being hitherto reported from Canada. Mr. Hill kindly donated one to the Society's collection.

J. ALSTON MOFFAT, London, Ont.

CANADIAN GALLS AND THEIR OCCUPANTS—AULAX NABALI, N. S.

BY WM. BRODIE, TORONTO.

Gall at the base of the stem of *Nabalus altissimus*, usually in masses surrounding stem, often extending down on main root, rarely on main fibres of root, usually about an inch under the ground, sometimes partly above the ground. Galls roughly spherical, 5 mm.—10 mm in diameter, each containing 1-10 cells, usually aggregated in irregular cylindrical masses of 2-14, resembling small knobby artichokes or irregular small white potatoes. The interior of the gall has the appearance and consistence of a raw potato. They are mature about the middle of September, and retain their white appearance through winter, but in spring the colour darkens. They dry up when the interior presents the appearance of a congeries of corky, fibrous folds. The average size of 20 of the cylindrical gall masses was, diameter, 14xx; length, 22xx. The cells are small, closely confining the larva.

In the spring of 1880 a friend handed me one of these galls, and informed me he had found it on the stem of an aster. For several seasons I carefully searched our asters, but failed in finding the gall, and it was not until the spring of 1885 when I found it on the root of *Nabalus altissimus*. My friend had mistaken the nude, dry stem of the nabalus for an aster.

In April, 1887, I made a collection of 33 gall masses from *Nabalus altissimus* growing on clay banks in open woods in St. James's Cemetery, Toronto.

The galls were at the base of the stem, immediately above root. Usually the mass of galls surrounded the stem; occasionally but a few on one side. From these galls I reared 115 producers—79 ♀s, 36 ♂s, and 57 parasites, ♂s and ♀s, of two species.

The producers came out 1-6-87—9-6-87; the parasites were a few days later.

A collection was made from *Nabalus* roots growing on clay soil in open woods a few miles north of Toronto, 20-10-88, and kept in a glass jar over winter. These galls were nearly spherical, 5x-10x dia., usually grown together in masses of 2-14, usually quite surrounding the stem, each nodule having from 1-10 cells.

These gave producers 17-5-89—28-5-89; parasites 21-5-89—1-6-89.

A collection of 71 gall masses made in Taylor's woods north of Toronto, 13-9-90, resembled artichokes or small white potatoes; the interior white, about the consistency of raw potato. Each nodule contained from 1-3 cells; cells small, closely confining larva.

These gave producers 13-5-91—20-5-91; parasites 19-5-91—1-6-91. ♀ producers were more numerous than ♂s.

A collection made from several localities near Toronto from stems of *Nabalis altissimus* growing on clay soil in open woods, 5-4-91, of 87 nabalis stems gathered 68 were gall bearing. The galls, as usual, a mass of rounded nodules surrounding base of stem an inch or two underground; occasionally a few nodules on one side of stem, rarely a few nodules extend into pith canal.

These gave parasites, *Eurytoma*, 5-5-91; producers first out 12-5-91; producers, 29 ♀s and 5 ♂s; out, 25-5-91; numerous parasites 9-6-91—25-6-91. One *Eurytoma* 22-7-91.

This lot of 68 gall masses containing probably 1,000 cells, gave of producers 153 ♀s and 81 ♂s, and of parasites, of 3 species, 185 ♂s and ♀s, a total of 419 specimens.

When collected in the fall season these galls may be kept in moist sand in a glass jar, but the occupants seem to be hardy, and do not appear to be injured by the drying of the gall. However, it is best to collect in April or early in May.

These galls have been increasing during the last ten years, and have now probably reached a maximum. The parasites are now becoming more numerous. The producer is held to be an undescribed species of *Aulax*, for which I propose the name *A. nabali*.

The following is a description:—

♀. Length 2.50xx. Antennæ 13 jointed, uniform brown, head and thorax black, abdomen shining brown, with a large anterior dorsal spot black; all the tibiæ, femora and tarsi brown, a little paler than the abdomen; wings ample, veins well defined, hyaline, iridescent at certain angles.

Abdomen of ♂ darker brown, and without the dark dorsal spot. From numerous specimens.

I have bred from this gall numerous specimens of the Braconid *Dacnusa crassitela*, Prov.

Provancher in his original description of this species gives Ottawa as the locality and Guignard as the collector. He does not say how the

specimen was obtained, nor does he say anything of the ♂, which differs considerably from the ♀.

I have also bred numerous specimens of the Chalcid *Eurytoma aulacis*, Ashm.; and I have reared two species of Coleoptera, probably accidental occupants, and many specimens of a Dipteron which Prof. Riley has kindly determined for me as of the genus *Leucopis*, sp. I am greatly indebted to the courtesy of Prof. Riley for this and many other identifications.

ENTOMOLOGY FOR BEGINNERS—No. 1.

NOTES ON KILLING, PRESERVING AND RELAXING INSECTS.

BY JAMES FLETCHER, OTTAWA.

The editor informs me that he wishes to publish in this year's volume of the CANADIAN ENTOMOLOGIST several short articles for the benefit of beginners and many others, who, although they do not aspire to being considered entomologists, yet would like to know something about our common insects, and the best way to preserve such interesting specimens as may chance to come in their way, until they may have an opportunity of mounting them for their own collections or giving them to interested friends. I have been asked to send some notes on the above subject.

There is perhaps no statement more frequently made to entomologists by observant travellers, or those who live in localities far removed from civilization, than "Oh! I wish you had been with me, I so often saw lovely insects; but I did not know how to save them for you." From novices the enquiry often comes, "What is the best way to relax specimens after they have become dry."

Killing and Preserving.—Having collected a specimen the first thing, of course, is to kill it. For beetles and hard-bodied insects nothing is simpler than to drop them for a second or two into scalding water; they must be taken out again at once and dried on blotting paper, or upon a cloth. The easiest way, however, for killing all insects is to make a "cyanide bottle." This may be made either by placing a small quantity of cyanide of potassium in the bottom of a wide-mouthed bottle and pouring in sufficient wet plaster-of-paris to cover it; or a hole can be hollowed out in the cork and a piece of cyanide inserted. This can be kept in place either with a plug of cotton wool, or a piece of chamouis

leather or linen may be tied over the cork. It must be remembered that the active principle of cyanide of potassium being prussic acid it is intensely poisonous—any left on hand after the bottle is made should be at once destroyed.

Insects put in this bottle will be killed in a few seconds by the poisonous fumes given off by the cyanide of potassium; they should then be taken out and packed away whilst soft and pliable. After a few days they become dry and are very easily broken. If there are only one or two specimens these may be wrapped in soft paper or cotton wool, and put away in a suitable box. If the collector, however, is likely to get several specimens, it will be well to prepare a box or bottle on purpose. Beetles or bugs may be preserved for a long time in clean saw-dust dampened with alcohol; grasshoppers, ants, wasps, bees, flies, etc., although they are far better preserved by being pinned at once after killing, may be packed away like beetles and bugs in tubes of paper. These are made by winding two or three thicknesses of a strip of paper $1\frac{1}{2}$ inches wide around a lead pencil, leaving about one-quarter inch over the end, which is turned in and pressed flat before taking the case off the pencil. Into this short, hollow tube drop the specimens and turn in the other end with the tip of a pencil, or fill up the mouth with a plug of cotton wool. Several specimens, according to their size, may be placed in each tube, and the date and locality having been written on the outside they are ready to be packed away in a dry place. Being slightly elastic and very light they pack closely, and a large number can be sent by mail at the same time.

Moths, butterflies and dragon-flies may be killed in the ordinary "cyanide bottle," and then placed in three-cornered envelopes made by taking small squares of paper and folding them across, almost in the middle, so as to make a triangular form with one flap a little smaller than the other, when the insect is placed between the two flaps, the two edges of the larger one are folded over the lesser, and the specimen is then ready to have the date and locality written on it and to be packed away where it will not be disturbed.

Relaxing.—The easiest way to soften insects is simply to place them in a covered jar upon damp sand for from 12 to 24 hours. A few drops of camphorated spirits dropped on the sand will prevent mould from forming on the specimens. Pinned specimens can be either placed in the sand jar or pinned upon a piece of cork and floated on water in a closed

jar, or in a basin with a damp towel over the top. Butterflies and moths stored in the envelopes mentioned above are best relaxed by putting the envelopes carefully without opening them, between the folds of a damp towel placed between two sheets of glass. The cloth should be wetted and then wrung out as dry as possible with the hands. Fold it smoothly and spread out the envelopes separately between the folds. Small butterflies and moths will relax in 12 hours and the largest in 24 hours. Beetles and bugs in paper tubes may be dropped into warm water and will be ready for setting in a few minutes; wasps, bees and flies should be placed in the sand jar to soften. Mr. W. H. Harrington, who uses these tubes extensively for all kinds of insects, finds that specimens can be conveniently relaxed by putting the tubes on a piece of wet blotting paper in the bottom of one saucer with another inverted over the top. The advantage of this plan is that if specimens should be accidentally forgotten, or it should be inconvenient to mount them at once, the small amount of moisture soon evaporates, and there is no danger of mould.

"BUTTERFLIES THAT BATHE."

In Goldthwaite's Geogl. Mag., Vol. 2, p. 738 (Nov., 1891), is a paper on "Butterflies that Bathe", giving observations of M. G. Lyell, jr., in Australia, on certain butterflies, species not stated, that "backed into the water until the whole of the body and the lower part of the hind legs were under water, the two forelegs only retaining their hold on dry land. After remaining in this position something like half a minute it flies away, apparently refreshed. During the morning I noticed a number doing the same thing. In one instance no less than four were to be seen within a space of not more than three yards * * *. While in the water the fluttering of the wings was suspended, and so intent were the butterflies in the enjoyment of the cold bath that they could hardly move, even when actually touched by the net * * *. Immediately upon emerging they flew up again to the hill sides." I do not know where this was originally published. Mr. W. G. Wright sent me the copy of the Geog. Mag., and remarked that it was a case of depositing eggs on plants in the water, and that the larvæ must be aquatic in their habits. I think there can be no doubt of that. Further observations on this butterfly would be welcome, and lepidopterists would be glad to know what genus and species has so unusual a habit.

W. H. EDWARDS, Coalburgh, W. Va.

AN EXPLANATION.

On the Report of the Entomological Club, as given in the CANADIAN ENTOMOLOGIST for November, pp. 246-247, I would make the following remarks:—

Mr. Smith's statement that there are two distinct series in the *Sphingidae*, as also that the *Smerinthinae* have their probable origin in Ceratocampid forms of the *Bombycidae* are both original with myself. The series *Hemaris*, *Choerocampa* and *Smerinthus* belong together. So far as I know, I am the first to show, from imaginal and larval characters, that *Choerocampa* and *Smerinthus* are allied, and I am the first to describe an ocellated Choerocampid from Brazil. The anal horn of the *Sphingidae* is to be regarded apparently as the last remnant of the *Bombycid* dorsal series of thorns. So far as known to me, I am the first author to point out that older Lepidopterous types occur in America than in Europe, and that from the study of our *Bombycid* fauna fresh suggestions are offered to the probable course of evolution in the order.

To the statement as to the *Zygaenidae*, p. 246, I would say that I followed Dr. Packard's views in his paper in the Essex Proceedings. Criticisms as to my arrangement in my Lists are sufficiently answered by this statement.

To the remark upon the *Dioptidae*, p. 247, I would state that I am not "responsible" for the reference of *Phryganidia Californica* to this family, but Mr. Butler, whose reference will be found in the pages of "Papilio".

To the remarks on the *Noctuidae*, I would state that I consider the group as one family with four unequal sub-family groups: *Thyatininae* m. (= *Thyatinidae* m.), *Noctuinae*, Pack., *Catocalinae*, Pack., and *Deltoidinae*, Lutr. I have shown in my writings that these groups are further divisible by sufficiently definable characters for classificatory purposes, and I have used the idea of tribes for these subdivisions in the Lecontean sense.

It is Mr. Smith's practice to take from my writings what he can use, without credit, and to hang upon minor points of difference, upon which I have nowhere insisted, criticisms which are generally uncalled for, and, as above instanced as to the *Dioptidae*, sometimes incorrect.

A. R. GROTE, Bremen, Germany.

MELITÆA PHAETON.

About the first of July I was informed by Mr. W. E. Saunders that shortly before, when out on one of his Ornithological and Botanical excursions, he had seen *Melitæa phaeton*, in a cedar swamp, two miles from Komoka station, which is ten miles west of London, on the Grand Trunk line. I took the first favourable opportunity of getting a sight of that insect alive, which occurred on the ninth. I found the swamp, and soon saw the butterflies disporting themselves in the sunny spots, seemingly quite plentiful. They would not have been difficult to secure had the footing been solid, but a previous heavy rain had set that afloat. I took five, and saw quite as many more during the short stay I made in the woods.

J. ALSTON MOFFAT.

CORRESPONDENCE.

PETROPHORA SILACEATA.

Dear Sir: At our recent annual gathering the Rev. T. W. Fyles had brought with him a box of insects for the purpose of obtaining their names if he could. Amongst them was a Geometer, which I recognized as identical with one I have had for four years awaiting a name. When Captain Geddes arrived he also had another of the same kind amongst the material which he had brought. As no clue to its identity could be obtained from the authors we consulted, I thought the time had now arrived when we ought to know something about it, so I applied at headquarters for information, going into communication with the Rev. Geo. D. Hulst, who kindly returned my specimen with the name *Petrophora silaceata*, Hub. It proves to be an exceedingly interesting species, widespread and variable. Mr. Hulst mentioned that one of his specimens is from Labrador, sent to him by Moeschler. As I could not find the name in any of our N. A. catalogues, I turned to the European, and found it in Edward Newman's "Illustrated Natural History of British Moths" as *Cidaria silaceata*, Hub. It is therein illustrated by figures of six well defined varieties. Newman does not give any variety names, but Mr. Hulst determines my specimen to be "var. *deflavata*, Stdgr.," yet it is not identical with any of Newman's figures, although closely resembling the sixth, which is one of the least ornate. Newman says: "The moth appears in May, and a second brood in August, and is regarded as common in England, Scotland and Ireland."

London, Dec. 18th, 1891.

J. ALSTON MOFFAT.

PROF. J. B. SMITH'S LIST OF LEPIDOPTERA.

BY G. H. FRENCH, CARBONDALE, ILL.

While I recognize the fact that each one of us has a right to make lists of insects to suit himself, and others are not obliged to follow them, errors of identity are not a matter of opinion, and are therefore subject to criticism. With this view I wish to point out a few errors in the genus *Catocala* in Prof. John B. Smith's new "List of Lepidoptera." First, var. *Virens*, French, is not a variety of *Cordelia*, Hy. Edw., but of *Amasia*; and *Cordelia* is not the one figured by Dr. Strecker, pl. 9, f. 12. My examples of *Cordelia* were identified by the author of the species. Second, there is no good reason for separating the two forms of *Retecta*. I have taken hundreds of them; they fly at the same time and behave alike in the woods, and grade into each other. *Flebilis* is not a variety of *Retecta*, but an insect of very different habits. Dr. Strecker's figure, so often referred to, pl. 9, f. 4, is not *Flebilis*, but a small form of *Desperata*. I had an example from Dr. Strecker, and have bred it from *Desperata* eggs. I cannot regard *Utalume* as a variety of *Lacrymosa*, as they have very different habits in the woods, as well as the differences of size and markings that are seen in the insects in cabinets. I have taken all the named forms of *Lacrymosa*, as well as numerous intergrades; have taken quite a number of examples of *Utalume*, but no intergrades with any form of *Lacrymosa*.

THE LARVA OF ANCERYX FASCIATA, SWAINS.

BY T. D. A. COCKERELL, KINGSTON, JAMAICA.

In July, 1891, Mr. I. I. Bowrey gave me a sphingid larva, about to pupate, which I described as follows:—

Larva.—Chærocampa-like, ground colour pale ochreous, sides immaculate. Dorsal region (sharply defined from sides) dark, from a close, fine black marbling or mottling, which tends to run in anteroposterior lines. A band-like process of this marbling enters the side area on each segment, obliquely projecting towards, but hardly reaching the spiracle.

Underneath the larva is more or less mottled, and there is a narrow black ventral line. Abdominal legs dark. Thoracic legs rather pale. Anterior part of fourth segment above heavily marked with black. Head pale, with a dark brown band down each side of the face. Caudal horn small and pale.

Food-plant.—*Carica papaya*, Linn. (West Indian Papaw.)

Hab.—Kingston, Jamaica.

The imago emerged Aug. 7th, and proved to be *Anceryx fasciata*.

The present larva differs appreciably from that of *A. edwardsii*, Butl., as described by Mr. Hy. Edwards in *Entom. Amer.* III., p. 165. So far as the larval characters go, *Anceryx* and *Dilophonota* (whether regarded as two genera or one) seem to belong rather to the Chærocampine than the Sphingineæ, with which they are placed in Prof. J. B. Smith's new list. The moths, also, while coloured like Sphingineæ, have a somewhat Chærocampa-like build.

BOOK NOTICES.

INSECTS INJURIOUS TO FOREST AND SHADE TREES, by Alpheus S. Packard, M. D., Ph. D. (Fifth Report of the Entomological Commission of the United States). 1 vol., 8vo., pp. 957. Washington: Government Printing Office, 1890.

About ten years ago (in 1881) what was then called the United States Entomological Commission, consisting of Messrs. Riley, Packard and Thomas—three very eminent men—issued a work by Dr. Packard on "Insects Injurious to Forest and Shade Trees" (Bulletin No. 7), a goodly volume of 275 pages, well illustrated and replete with valuable information. Recently a revised and much enlarged edition of this publication has been issued by the Department of Agriculture at Washington, bringing the original work more nearly down to date, and furnishing, as far as possible, a complete manual on the subject. The new volume is more than three times the size of the former edition, consisting of no less than 950 pages, illustrated by over 300 wood cuts and forty plates, twelve of which are coloured. Some idea of the extent of the work, as well as of the importance of the subject, may be found from the fact that descriptions are given of over three hundred species of insects that affect the oak, and the names of nearly 150 more are mentioned; sixty-one are described as attacking the elm, and thirty more mentioned; one hundred and fifty-one described that affect the pine, and a list of twenty more given; and so on for a large number of other trees. Economic entomologists for the most part devote their attention to the insects that attack fruit trees, crops and vegetables, as these most directly affect the public; but surely no more important matter can be studied than the preservation of our forests, which are annually being depleted for the purposes of commerce, as well as by fire and insects. It is high time that more attention was paid to this matter, and that people generally should be aroused to the dangers that will surely result if we allow our country to be stripped of its woods and forests. In some countries of Europe, notably in Germany, a very rigid oversight of the forests is maintained by the government, and no wanton or careless destruction is permitted. In connection with this, they encourage scientific men to devote their studies to the insect enemies of trees, and as a result some magnificent books have been published, chief among these are the grand work of Ratzeburg and the perhaps less widely known publications of Kaltenbach. Alongside of these Dr. Packard's book will assuredly take its place, as his work is

very carefully and completely done. The life-history of each insect described is as far as possible fully given; the best published descriptions of each stage are quoted and references given wherever the author has not made personal observations himself, or whenever he thinks that someone else's record is better or fuller than his own. Thus the work is made complete to date, and succeeding observers will know what investigations have been made, and what remains to be done in this vast field of entomological research. The coloured plates are beautifully and accurately done, and the wood cuts and other illustrations give careful details or full representations of a large number of the insects referred to in the text. Such a publication ought to encourage our own Government to follow the noble example set them in this respect at Washington.

A SERIES OF THIRTY COLOURED DIAGRAMS OF INSECTS INJURIOUS TO FARM CROPS. Drawn from nature by Miss Georgiana E. Ormerod. W. & A. K. Johnston, London, England, 1891.

These diagrams are beautifully and accurately executed, and will be found most useful by any one who is called upon to lecture to classes in entomology, or give addresses to farmers' institutes. They are sufficiently large, being thirty inches long and twenty-two wide, to be seen at some distance in a hall or class-room, and will serve to illustrate descriptions of an economic character. Though intended for England, nearly all of them are equally applicable to this country. They are divided into five sets of six each, which deal with the following objects:—(1) Common Insect Attacks: Ox Warble Fly, Horse Bot-fly, Large White Butterfly, Cockchafer, Turnip Flea-beetle, Onion Fly; (2) Insects Affecting Various Kinds of Crops: Surface Caterpillars, Daddy Longlegs, Eel-worms, Plant Bugs, Hessian Fly, Wire-worm; (3) Insects Affecting Particular Crops: Mangold Fly, Hop Aphis, Bean Beetle, Corn Thrips, Gout Fly, Corn Saw-fly; (4) Insects Affecting Fruit Crops: Winter Moth, American Blight (Aphis), Gooseberry and Currant Saw-fly, Apple Blossom Weevil, Codlin Moth, Magpie Moth; (5) Insects Affecting Trees: Pine Beetle, Pine Weevil, Pine Saw fly, Goat Moth, Spruce Gall Aphis, Leopard Moth. The diagrams are sold singly at one shilling and sixpence each, or in sets. On each is shewn the natural size of the insect as well as the greatly enlarged picture, a very necessary matter, as otherwise most erroneous impressions are formed by the ignorant of the real dimensions of the creature referred to. There is also printed on each a general description, by Miss Eleanor A. Ormerod, of the life-history of the insect depicted, and of the best remedies to be employed against it.

A MANUAL OF NORTH AMERICAN BUTTERFLIES, by Charles J. Maynard : 8vo., pp. 226. Boston : DeWolfe, Fiske & Co., 1891.

We are always glad to welcome the publication of a new book which is likely to render more easy, and consequently to popularize, the study of entomology. The author of the work before us has, no doubt, had this object in view when preparing this manual, in which are brought together "for the first time, descriptions of all the species of butterflies which occur in North America, north of Mexico." He has evidently taken a great deal of pains in the execution of his task, and expended much labour upon the descriptions of over six hundred and thirty species of butterflies, and in the preparation of the illustrations, for "not only is a coloured plate given of one species of nearly all the genera, but wood cuts are given of some portion of about 250 species, illustrating some peculiar character by which the insect may be known ; both plates and wood cuts have, with a single exception, been drawn and engraved by the author himself." The wood cuts, giving a wing, or a portion of a wing, of a number of closely allied species, will be found very useful helps by any one employing the book for the identification of his specimens, and are much superior to the coloured plates. Anyone with a large stock of specimens on hand, and with a few named in different genera to start with, will find this book a very useful and handy manual for the naming of his material, but this, we fear, is the extent of its value. The author has adopted the comparative method in his descriptions, which involves a constant reference to some other species, which the beginner in the study may chance not to have, and be woefully puzzled in consequence. There are no synopses, or comparative tables, of either genera or species given, but the author selects a species as his "type" and compares the other members of the genus with it. If the student possesses a specimen of this typical species his way will be fairly easy, but without it the investigation will be sadly difficult, if not hopeless. Another very serious defect in the book is the entire absence of all reference to the preparatory stages of the insects, and consequently to their food-plants, habits, dates of appearance, etc. We trust that the author may be enabled to issue a second edition of the work, and make it a thorough and complete "manual" by remedying the defects that we have referred to. That this may be done in a concise form and in a most useful manner is admirably proved by Stainton's "Manual of the British Moths and Butterflies," which we would commend to our author as a model for imitation when he enters upon the preparation of his next edition.

Mailed January 14th.

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